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FIBER OPTIC CONE PENETROMETER RAMAN PROBE FOR IN SITU CHEMICAL CHARACTERIZATION OF THE HANFORD UNDERGROUND WASTE TANKS*

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There exist 177 underground storage tanks at the US Department of Energy (DOE) Hanford site that have been used by the DOE complex to process and store over 100 million gallons of chemical and mixed chemical/radioactive wastes generated from nuclear weapons and fuels production. The DOE is currently in the process of retrieving, treating, and safely disposing of the wastes stored in underground tanks. Prior to retrieval and treatment, characterization is required of the wastes stored within the tanks to identify the chemical and radioactive composition to determine if waste transfer can occur within normal safety rules involving flammability, corrosiveness, and chemical compatibility. Examination of both the basic physical and chemical parameters of the tank wastes are required to ensure continued operability during waste transfer and concentration/minimization. Current techniques of tank waste analysis involve the removal of core samples from the tanks, followed by costly and time consuming wet analytical laboratory testing. Savings in both cost and time could be realized in techniques that involve in situ probes for direct analysis of tank materials in their native environment. To address the chemical safety and operational needs, LLNL was contracted to provide a fiber optic remote Raman chemical sensor system for incorporation in an in-tank cone penetrometer.

The Hanford tank environment provides unique materials challenges in terms of chemical, radiation, and operational parameters. Chemically, the typical tank waste matrix is an extremely complex heterogeneous mixture consisting of an alkaline ($8 \leq pH \leq 14$, up to 5 M NaOH) blend of solid and dissolved inorganic oxidizing agents such as sodium nitrate and sodium nitrite ($\leq$ 5M) and organic chelating agents and solvents. Radiation fluxes of up to 10,000 Rad/hour exist within the waste, primarily gamma and beta radiation from the

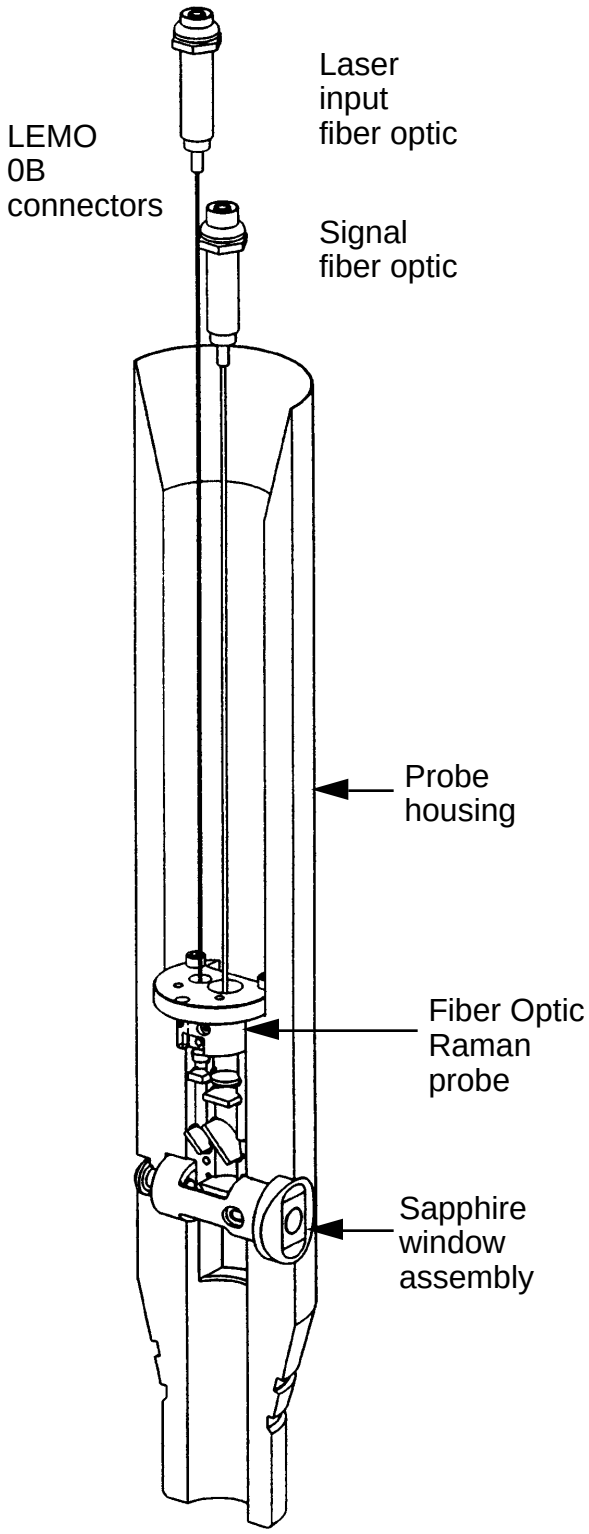

Figure 1. Cone penetrometer Raman probe, probe housing, and sapphire window assembly.

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